

## APPENDIX

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**54 Visually Identifiable, Optical Security Element for Security Papers**

**57 Visually identifiable, optical security elements for security papers or other objects to be safeguarded has at least two partial areas identifiable with the naked eye and apparently differently structured when exposed to light. The structure of at least some of the partial areas is such that when the lighting or observation direction is changed the visible optical image also changes. The essential aspect of the security elements is that their partial areas are structured in such a way that adjacent partial areas have a clearly contrasted appearance for an observer, whereas each partial area has a uniform structure**

## Description

The invention relates to visually identifiable optical security elements for security papers, such as bank notes, credit cards, passports or cheques, or other objects requiring safeguarding, which have at least two partial areas, which are identifiable with the naked eye and exhibit visibly different structures when exposed to light.

Such optical security elements that change their appearance depending on the observation angle or lighting conditions are primarily used for credit cards but also for other purposes. So far, the efforts are directed towards combining as many different optical effects as possible, such as color changes, motion effects, holographic effects, three-dimensional appearance forms, in order to make counterfeiting of the security element as difficult as possible. However, the disadvantage of this is that such a security element, due to its unspecific appearance/image, cannot be authenticated, for instance, by the lay person and under the conditions of general monetary transactions, where poor lighting prevail and only a short time for authentication is available. Hence, such known optical security elements (so called OVDs) can factually make counterfeiting of the security elements difficult; however, authentication is only possible with the help of appropriate devices or complex visual authentication, and cannot be done quickly by a lay person. Another drawback is the fact that the unspecific appearance/image of the different effects contained in one motive, and overstrained OVDs due to the amount of information offered, can be reproduced with color copiers or printing methods without being detected by the lay person. Consequently, the achieved security effect is comparatively marginal, despite the considerable complexity of producing the OVDs.

Therefore, the goal of this invention is to design a visually identifiable, optical and appearance changing security element in such a way that it can quickly and easily be verified by a lay person even under adverse lighting conditions, whereby the use of special instruments or devices in order to verify the authenticity is not required. In addition, it is intended to prevent the reproduction of the effect of the OVDs with the help of print- and copy media.

In order to achieve this goal, it is suggested that a security element, in accordance with the present invention as described above, has partial areas that are structured such that adjacent partial areas have a clearly contrasted appearance for an observer or whereby homogeneously appearing areas have a contrasting appearance when counterfeited, whereas each partial area has a uniform structure. In the easiest case scenario, the security element comprises only two clearly distinguishable partial areas, each respectively uniform, so that it would be sufficient for the observer to only memorize the optical effects of the two partial areas.

The present invention relies on the basic consideration that it is important for the easy and quick verification, even under adverse lighting conditions, to limit the number of different and obvious optical effects, whereby the individual optical effects are intended for certain partial areas of the security element, which are adequately large and, preferably, have a certain shape in order to be easily and quickly identifiable and distinguishable by the observer. The identification is further aided by the fact that the partial areas, having a contrasting appearance to each other or appear contrasting if reproduced, have one uniform structure. For that matter, it is practical that at least several partial areas are designed such that the desired optical effect is clearly visible even under adverse lighting conditions or diffuse or minimal light. Examples of such easily recognizable effects would be color changes, distinct movements or form changes in the area of light visible to the observer, or clearly visible changes between structured and highly reflective areas.

It is within the scope of the invention that at least one partial area of the security element has a diffractive and/or refractive structure (diffractive structure), for example a hologram, interference pattern, diffractive grating or such, whereby, depending on the diffractive structure used, many different effects can be achieved. Appropriately, the diffractive structure can be arranged such that a change in the lighting or observation angle results in a defined and distinct change in color. Another option according to the invention is that the diffractive structure, following a change of the lighting or observation angle, produces a moving effect, for instance color shifting or change of

geometric images. Finally, it is also possible that the diffractive structure is comprised in such a way that, depending on a certain observation angle, one partial area displays two or more geometrical images, such as two different letters or, on the other hand, a change between a letter or a number and the picture of a head.

Distinct and obvious optical effects are also achieved in cases where the different partial areas of the security element have variable degrees of reflectivity.

It is within the scope of the invention, that at least one partial area exhibits a matt structure, which could be either a chromatic or achromatic matt structure.

Another possibility of designing the partial areas would be such that at least one partial area is not visibly structured, whereby the at least one partial area is luminous, preferably metallically highly reflective. Particularly, the contrast between a highly reflective and regardless of the observation or lighting angle uniform partial area, and a partial area that changes its appearance depending on the observation or lighting angle is a characteristic, which the observer can easily memorize.

Another alternative of a different design of the partial areas, which are easily identifiable by the observer, is that adjacent partial areas are of different color, whereby the different color is appropriately composed of a transparent paint/varnish, which at the same time functions as a protective layer by covering the structure so as to prevent deliberate or unintentional scratching or modification of the structure, as long as the partial areas consist of a diffractive or matt structure.

According to the instant invention, the proper identification of the individual partial areas is safely guaranteed when each partial area has a minimum diameter or a minimum measurement in each direction of at least 0.3 mm, and preferably of at least 2 mm.

The recognizability or identification of a security element according to the invention is further facilitated when a first partial area encircles another partial area like a frame, whereby preferably the first frame-like partial area encircles at least two additional partial areas, which are separated from each other by a gap. It is preferable in this embodiment that the first, frame-like partial area is glossy, while the one or more additional partial area(s) exhibit(s) a diffractive or matt structure. The reflective or glossy frame will prompt the observer to pay attention to the partial areas within the frame. Such a design allows the observer to notice clearly visible contrasting effects even in color copy reproductions, whereby the more or less chromatic, low optical density reproduction of the diffraction-optical effective structural area is clearly silhouetted against the high gloss finished, high density reproducible partial areas.

It is also possible, in the context of this invention, that at least one partial area is comprised of a thin-layer element, whereby that thin-layer element is designed to be a transparent, generally colorless layer, whose thickness is so thin that interference effects occur. To this end, the layer has to be thinner than one quarter of the applied light's wavelength.

If, as is feasible according to the invention, at least one partial area of the security element is transparent, the result is a particular optical effect, which is easily recognizable by the observer. Furthermore, it has the advantage that the surface of the security document, such as an appropriately printed paper, shows through the area of the security element. This embodiment is very difficult to achieve with attempted counterfeiting.

In addition, it is possible that at least one partial area is distinguished from its adjacent partial area(s) by partially removing the plating covering several partial areas. The method of removing plating is chosen when the goal is to create transparent partial areas or to partially hide a diffractive structure covering the complete security element and partitioned into different partial areas.

Additional protection of the security document can be achieved by introducing at least one other security feature to the security element. The additional security feature could consist of a print or imprint that covers all partial areas at least partially, whereby said print or appropriate imprint is usually applied after the security element is applied to the security document.

The additional security feature of a special imprint is advantageously composed of special paints, such as mineral or metallic effect paints, liquid crystal paints or coating, IR and/or UV-active paints, daylight luminescent paints or iridescent paints.

Another option to create an additional security feature is to specially design the diffractive structure of at least one partial area of the security element such that it is difficult to forge.

As the above description shows, the goal of the security element according to the invention is to utilize only a few, for instance two, selected effects that achieve a high level of attention. These effects, which have distinct optical properties, are applied to the security element according to the invention such that at least individual elements are clearly visible and effective even under poor lighting conditions. Appropriately, the effects themselves are presented in a easily recognizable shape, for instance as a tangible symbol or picture on the bank notes design, whereby good results are achieved from the inter-relation between highly reflective, optically non-diffractive partial areas on one hand and optically diffractive partial areas on the other hand. The use of highly reflective partial areas has the additional advantage that the highly reflective surfaces appear black in copied or color-printed imitations, whereas optically diffractive structures are reproduced in diffuse and non-specific colors. These differences would be easily detectable even under unfavourable conditions during the monetary exchange.

Basically, it is possible to create the security element according to the invention in many different ways, particularly with regard to applying it to a security paper. With respect to handling and attachment to the security document, it is appropriate that the

security element according to the invention is part of an embossed or laminated film, which features an adhesive layer for adhering the security element to the security document or object. Methods of producing such embossed or laminated films are well known and as a result will not be elaborated on. For a person skilled in the art, it is self-explanatory how for instance heat embossed films have to be designed in order to achieve certain optical effects, such as highly reflective surfaces or surfaces exhibiting a diffractive structure.

Additional features, details and advantages of the present invention are clarified in the following description of preferred embodiments of security documents with security elements according to the invention, which schematically show in;

**Fig. 1**, a part of a security document with a first embodiment of a security element;

**Fig. 2**, a cut along line II-II in Fig. 1; and

**Fig. 3** a part of a security document with a second embodiment of a security element according to the present invention.

Fig. 1 illustrates part of a security document 1, such as a bank note, etc., to which is applied a security element 2 according to the present invention.

The embodiment of Fig. 1 shows the visually identifiable, optical security element 2, which primarily comprises partial areas 2a, 2b, and 2c, whereby these partial areas are measured such that they have a minimum measurement in each direction or a minimum diameter of at least 0.3 mm, preferably of at least 2 mm. That means that the frame-like partial area 2a has a frame width of at least 0.3 mm, more practically though of at least 2 mm. Accordingly, partial areas 2b and 2c are at least 0.3 mm, preferably at least 2 mm, wide and high.

As indicated in the embodiment of Fig. 1, the frame-like first partial area 2a is reflective, such as a high gloss finished plating.



Partial areas 2b and 2c show different diffractive or refractive optically effective surfaces, respectively. The surface of partial area 2b, for instance, can be comprised of a diffractive structure that produces a change of color, while the surface of partial area 2c is designed such that a change in the lighting or observation angles produces color shifting, for instance subject to a beam rotation, which has been known for some time from decorative foils.

Within partial areas 2b and 2c of the embodiment of Fig. 1, there are arranged additional structures 2d and 2e in the shape of letters "A" or "X", whereby said structures 2d and 2e differ from the rest of the partial areas 2b and 2c with respect to their surface characteristics. Based on the embodiments of Fig. 1 and 2, for instance, the surfaces of letters "A" and "X" can exhibit a matte structure. Attaching letters or the like is functional when the security document is a bank note. In that case, the letters "A" and "X" can be interchanged with the respective short form of the respective currency, for instance the letter combination "DM" for Deutsche Mark.

As is obvious from Fig. 1, the frame-like partial area 2a surrounds the partial areas 2b and 2c in such a way that there is a small gap 3 between partial area 2a and the partial areas 2b and 2c. Likewise, partial areas 2b and 2c are separated from each other by a small gap 4, whereby the security element has no surface structure in the gap areas 3 and 4. More exactly, gap areas 3 and 4 in the embodiment as shown, are transparent so that the surface 5 of the security document 1 is visible through the gap areas 3 and 4 inside the security element 2. This detail improves the effectiveness of the security element.

The security element 2 in the embodiments of Fig. 1 and 2 is part of a heat embossed film, which is particularly apparent in Fig. 2, and is applied according to the appropriate procedure, which means that it is transferred by a carrier 6 to the surface 5 of the security document 1, using a stamp while applying heat and pressure.

In addition, Fig. 2 illustrates the design of the security element 2 in detail.

It is comprised of the carrier film 6, a transparent, deformable protective paint layer 7, a paint layer 8, as well as, an adhesive layer 9 to facilitate bonding to the surface 5 of the security paper 1.

Appropriate diffractive or matt/pearl structures are situated on the interface 10 between the transparent, deformable protective paint layer 7 and the paint layer 8, whereby these structures are created by stamping the protective paint layer 7 while it is still deformable

As is evident in Fig. 2, partial area 2b contains diffractive structures 11, which are primarily in the shape of parallel lines of a certain linear frequency and depth. On the other hand, the area 2d of the letter "A" exhibits a matt/pearl structure 12, which reflects light diffusely. Outside of the partial area 2b, in particular in the gap area 3 and the glossy frame 2a, the surface 10 is flat between the paint layers 7 and 8.

In order to make the diffractive and matt/pearl structures clearly visible and to create the highly reflective surface of frame 2a, plating 13 is applied between the two paint layers 7 and 8, whereby the plating is removed from the gap area 3 between the frame 2a and the partial areas 2b and 2c.

Finally, Fig. 2 suggests that the protective paint layer 7 in section 14, which is analog to partial area 2b, can be dyed, whereby the dyeing has to happen in such a way that the protective paint layer 7 remains transparent in order to ensure that the partial areas 2a, 2b and 2c of the security element 2 on the security document 1 are clearly visible. By transparently dyeing the protective layer 7 in section 14 it is possible to use color to distinguish the two partial areas 2b and 2c from each other or from the frame 2a, as well as, from the surface 5 of the security document 1.

The heat embossed film, which is used to create the security element 2 on the security document 1 according to Fig. 1 and 2, is manufactured in a conventional way.

First, a transparent protective paint layer 7 is applied to an appropriate carrier 6, through a conventional print method, whereby the use of a print method allows the application of differently colored partial areas. While the protective paint layer 7 has not fully hardened or –if a thermo plastic varnish is used for the protective paint layer 7 – with the help of heat, the structure 11, 12 is introduced by way of an appropriate replicating process. Following that, a soluble, preferably water-soluble varnish is applied, for instance, to the area where the non-metallic gaps 3 and 4 will be. Then, the partially structured surface of the protective paint layer 7, which is not facing the carrier 6, is furnished with a plating 13; for instance, by way of vacuum metallization with an appropriate aluminum layer. Once the plating 13 has been applied, it is then removed from gap areas 3 and 4 through elution of the water-soluble varnish layer and appropriate stripping of the metal layer. In order to finish the heat embossed film, the additional paint layer 8 and, if necessary, the adhesive layer 9 are applied.

The embodiment of Fig. 3 also shows a security document 1, such as part of a bank note, whereby in this case the security element 20 consists of four equally sized partial areas 20a, 20b, 20c, and 20d, which simply exhibit different surface structures, which is indicated by the different types of shading. For that matter, the term “surface structures” does not only relate to topology according to the embodiment of Fig. 2. The “surface structures” of partial areas 20a to 20d can also be created by applying different coloring, by using appropriately thin layers of varnish, or through varying reflectivity, etc. Nonetheless, it is particularly advantageous for a configuration according to Fig. 3 that the partial areas 20a to 20d exhibit a specific change in color, such as color shifting from left to right and reverse from right to left, depending on the observation angle.

According to the embodiment of Fig. 3, there is an additional security feature, namely an imprint 21, which covers all partial areas 20a to 20d of the security element 20, whereby it is advisable that the imprint 21 consists of self-contained and uninterrupted lines, which complicates forgery considering that a continuous imprint makes it almost impossible to cut out parts of the security document and to replace them with others.

In addition, it is general practice to use special color for the imprint 21, such as colors with mineral or metallic effects, liquid crystal colors or laminates, IR- or UV-active colors, daylight luminescent colors or iridescent colors. The use of these special colors allows an additional authenticity inspection with the use of special light, whereby the imprint will then either glow or adopt a certain color, depending on the wavelength used for lighting.

Additional security features do not always have to be obtained through printing or embossing. For instance, it is also possible to add an optical structure to partial areas 20a to 20d, which is difficult to counterfeit, and the design of which is only identifiable with the help of special instruments, using at least a magnifying glass.

The aforesaid description primarily illustrates the application of the security element according to the invention to security papers. It is understood, however, that the security element according to the invention can also be applied to other objects, in particular on plastic cards, surfaces of objects, etc., whereby the targeted advantages are also achieved in these cases.

## Claim

1. Visually identifiable optical security element for security papers, such as bank notes, credit cards, passports or cheques, or other objects requiring safeguarding, which have at least two partial areas identifiable with the naked eye and apparently differently structured when exposed to light, whereby the partial areas (2a to 2e, 20a to 20d) of the security element (2, 20) are structured such that adjacent partial areas have a clearly contrasting appearance for an observer or whereby homogeneously appearing areas have a contrasting appearance when counterfeited, whereas each partial area has a uniform structure.

2. A security element according to claim 1, whereby at least one partial area (2a to 2e, 20a to 20d) has a diffractive and/or refractive structure (diffractive structure), for example a hologram, interference pattern, diffractive grating or the like.
3. A security element according to claims 1 and 2, whereby the diffractive structure (11) produces a defined and distinct change in color when the lighting or observation angle changes.
4. A security element according to claims 1 and 2, whereby the diffractive structure (11) produces a moving effect, for instance color shifting or change of geometric images when the lighting or observation angle changes.
5. A security element according to one of the previous claims, whereby the partial areas (2a to 2e, 20a to 20d) of the security element (2, 20) exhibit different reflectivity.
6. A security element according to one of the previous claims, whereby at least one partial area (2d, 2e) exhibits a matt structure (12).
7. A security element according to one of the previous claims, whereby at least partial area (2a) is not visually structured.
8. A security element according to claim 7, whereby the at least one partial area (2a) appears reflective.
9. A security element according to claims 7 and 8, whereby the at least one partial area (2a) is metallicity highly reflective.
10. A security element according to one of the previous claims, whereby adjacent partial areas (2a; 2b; 2c) exhibit different colors.
11. A security element according to claim 10, whereby the different color consists of a transparent color paint (7), which at the same time functions as protective lacquer and at least in partial areas (2b, 2c) has a diffractive (11) or matt structure (12).
12. A security element according to one of the previous claims, whereby each partial area (2a to 2e, 20a to 20d) has a minimum diameter or a minimum measurement in each direction of at least 0.3 mm, and preferably of at least 2 mm.
13. A security element according to one of the previous claims, whereby at least one partial area (2a) frame-like encircles at least one other partial area (2b, 2c).

14. A security element according to claim 13, whereby the frame-like first partial area (2a) encircles at least two additional partial areas (2b, 2c), which are separated from each other by a gap.
15. A security element according to claims 13 or 14, whereby the frame-like, first partial area (2a) is reflective and the one or several partial areas (2b, 2c) exhibit(s) a diffractive (11) or matt structure (12).
16. A security element according to one of the previous claims, whereby at least one partial area (2a to 2e, 20a to 20d) consists of a thin layer element.
17. A security element according to one of the previous claims, whereby at least one partial area (3, 4) is transparent.
18. A security element according to one of the previous claims, whereby at least one partial area (3, 4) is created differently compared to the one or several adjacent partial area(s) (2a to 2c) by removing plating (13), which covers several partial areas (2a to 2e).
19. A security element according to one of the previous claims, which contains an additional security feature (21).
20. A security element according to claim 19, whereby the additional security feature (21) consists of a print or imprint that covers all partial areas (20a to 20d) at least to some extent.
21. A security element according to claims 19 or 20, whereby the additional security feature is created with special colors.
22. A security element according to one of claims 19 to 21, whereby the additional security feature is created by specially designing the diffractive structure of at least one partial area of the security element such that it is difficult to forge.
23. A security element according to one of the previous claims, whereby the security element (2, 20) is part of an embossed or laminated film (6, 7, 8, 9), which exhibits an adhesive layer (9) to adhere the security element (2) to the security document (1) or object.

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